

CSE 2312-001
Computer Organization
and
Assembly Language Programming
Fall 2018

Instructor: Fred Kashefi

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Faculty Profile: [Fred Kashefi](#)

Office Hours: Mon/Wed/Fri 10:00 am -12:00 pm OR by appointment.

Section Information: CSE 2312-001

Time and Place of Class Meetings: Mon/Wed: Sec-001- 1:00 – 2:20 pm (ERB – 131)

Graduate Teaching Assistant:

Section 001

Name: Lakshay Sharma

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Office Hours: TBA

Lab Rooms with QEMU and ARM Software: ERB 124, 125, and 131

Description of Course Content: Computer organization from the viewpoint of software, including: the memory hierarchy, instruction set architectures, memory addressing, input-output, integer and floating-point representation and arithmetic. The relationship of higher-level programming languages to the operating system and to instruction set architecture is explored. Some programming in an assembly language.

The course is comprised of 3 parts:

- i. **Introduction**– Students will be briefly going over the history and evolution & revolution of computers. Students will also be introduced to the working of a computer and see how the different components of computer interact for its harmonious operations.
- ii. **Instruction Set Theory & Language of Computing** – The words of a computer’s language are its instructions and its vocabulary is called its INSTRUCTION SET. The students will become familiar about how a computer deals with the Instruction Set and convert it to binary (the language that the computer actually understands), and vice-verse.
- iii. **Final Phase** – finally we will bring all the topics together to get a more practical, real world experience about computer architecture with some advanced theory and programming.

Student Learning Outcomes: The objective of this course is to introduce computer science and engineering students to the architecture, organization, and low-level (assembly) programming of computing systems. At course conclusion, students should be able to:

- Define components of a computer system, such as input/output devices, memory, processors, etc.
- Define different types and levels of computer systems, such as instruction set architectures, device level architectures, microcontrollers, RISC, CISC, etc.
- Compute and compare basic performance metrics of programs on different architectures and levels
Convert between binary and decimal representations, binary and character encodings like ASCII, real

numbers and floating-point approximations, and perform manipulations of these information representations (arithmetic, etc.)

- Write, assemble, and execute assembly language programs to solve problems
- Write assembly programs using different endianness, addressing modes, stack features, and other architecture and ISA specific features

Required Textbooks and Other Course Materials:

- David A. Patterson and John L. Hennessy, [Computer Organization and Design, Fifth Edition: The Hardware/Software Interface](#), Morgan Kaufmann, September 2013 (Required, Main Textbook; [Book Website](#))
- Using [zyBooks](#) (Online)
 1. Sign in or create an account at [learn.zybooks.com](#)
 2. Enter zyBook code: **UTACSE2312KashefiFall2018**
 3. Subscribe*A subscription is \$72 and will last until December 22, 2018.*
- Quick-EMUlator (QEMU): [Overview](#), [Homepage](#)
- ARM and Thumb-2 Instruction Set [Quick Reference Card](#)
- ARM [Instruction Summary](#)
- ARM [Register Names](#)
- ARM [Memory Map \(See Section 4.1, 32-bit memory map\)](#)

Optional Textbooks and Additional References

- Pete Cockerell, [ARM Assembly Language Programming](#) (Online)
- Introduction to ARM Assembly [Web Course](#)
- Stack Overflow: [ARM Assembly Suggestions](#)
- ARM [Floating Point Register Names](#)
- ARM [Directives](#)
- ARM [Condition Codes](#)
- ARM [Detecting Overflow of Arithmetic Operations \(Addition\)](#)
- ARM [Detecting Overflow of Arithmetic Operations \(Multiply\)](#)
- ARM [Conditional Execution](#)
- ARM [versatilepb Manual](#)
- ARM [PrimeCell UART \(PL011\) Manual](#)
- ARM [Floating Point Instructions](#)
- GNU ARM [Assembler \(as\) Manual](#)
- [ARM gcc](#)
- Andrew S. Tanenbaum, [Structured Computer Organization, 6th Edition](#). Prentice-Hall, Inc., 2012. (Optional; focuses primarily on x86)
- Kip Irvine, [Assembly Language for Intel-Based Computers, 6th Edition](#), Prentice-Hall, Inc., 2011. (Optional; focuses on x86)
- Paul A. Carter, [PC Assembly Language](#), July 2006. (Optional; focuses on x86; [Free PDF Available](#))

Descriptions of major assignments and examinations: Coursework for roughly the first half of the course will include homework assignments and a midterm exam covering roughly chapters 1, 2, and 3 of the Patterson and Hennessy textbook. The second half of the course will include fewer homework assignments, but several programming assignments in assembly language, and a final exam cover roughly chapters 4 and 5 of the Patterson and Hennessy textbook. In class or online quizzes and discussions will make up a portion of the grade. Approximate due dates of assignments are shown in the course schedule.

Attendance: At the University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator in student success. Each faculty member is free to develop his or her own methods of evaluating students' academic performance, which includes establishing course-specific policies on attendance. As the instructor of this section. However, while UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients "begin attendance in a course." UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student, a grade of F, faculty report the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Blackboard. This date is reported to the Department of Education for federal financial aid recipients.

Other Requirements: Exams will be closed book, but students will be allowed to bring a two-sided sheet of letter-size paper. Students are expected to check the course website for updates to the course schedule throughout the semester.

Grading: Grade percentages will be calculated based on the following weights:

• Homework	15%
• Programming Assignments	30%
• Quizzes and Participation	15%
• Midterm Exam:	20%
• Final Exam:	20%
=====	=====
Total	100 %

Letter grades will be determined based on the following ranges:

Final Grade =	$0.15 \times \text{HW} + 0.30 \times \text{Prog_Assignments} + 0.15 \times \text{Quiz} + 0.20 \times \text{Mid_Exam} + 0.20 \times \text{Final_Exam}$
A	90 - 100%
B	80 - 89 %
C	70 - 79%
D	60 - 69%

The instructor reserves the right to move the thresholds down based on the distribution of final percentages, but they will not move up (e.g., if a grade percentage is between 90 and 100, this will receive an A). Students are expected to keep track of their performance throughout the semester and seek guidance from available sources (including the instructor) if their performance drops below satisfactory levels.

Make-Up Assignments and Exams:

If you miss an exam or quiz due to unavoidable circumstances (e.g., health), you must notify the instructor in writing via email as soon as possible and request a makeup approval. If it is a planned (non-emergency) absence, you must inform the instructor ahead of time! Do NOT ask for make-ups if you do not complete something due

to travel (except when you are required to travel to represent the university or department on official business but request at least 3 days ahead of the due date or exam time).

Grade Grievance Policy:

Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current undergraduate catalog (see [here](#)).

The first step is as follows. If you do not believe a grade on a particular assignment is correct, you may appeal the grade in writing (by email) within 5 days. Grade appeals must be appealed to the appropriate GTA first, then to the instructor if necessary.

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance.** Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://www.uta.edu/aao/fao/>).

Disability Accommodations: UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including *The Americans with Disabilities Act (ADA)*, *The Americans with Disabilities Amendments Act (ADAAA)*, and *Section 504 of the Rehabilitation Act*. All instructors at UT Arlington are required by law to provide “reasonable accommodations” to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of **a letter certified** by the Office for Students with Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting: **The Office for Students with Disabilities, (OSD)** <http://www.uta.edu/disability/> or calling 817-272-3364. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability.

Counseling and Psychological Services (CAPS) www.uta.edu/caps/ or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

Non-Discrimination Policy: The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit uta.edu/eos.

Title IX Policy: The University of Texas at Arlington is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. *For information*

regarding Title IX, visit www.uta.edu/titleIX or contact Ms. Michelle Willbanks, Title IX Coordinator at (817) 272-4585 or titleix@uta.edu

Academic Integrity: Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.

I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

UT Arlington faculty members may employ the Honor Code in their courses by having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents' Rule* 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University. Additional information is available at <https://www.uta.edu/conduct/>. Faculty are encouraged to discuss plagiarism and share the following library tutorials <http://libguides.uta.edu/copyright/plagiarism> and <http://library.uta.edu/plagiarism/>

Electronic Communication: UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

Campus Carry: Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>

Student Feedback Survey: At the end of each term, students enrolled in face-to-face and online classes categorized as "lecture," "seminar," or "laboratory" are directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student's feedback via the SFS database is aggregated with that of other students enrolled in the course. Students' anonymity will be protected to the extent that the law allows. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit <http://www.uta.edu/sfs>.

Final Review Week: for semester-long courses, a period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except

makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Emergency Exit Procedures: Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

Student Support Services: UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include [tutoring](#), [major-based learning centers](#), developmental education, [advising and mentoring](#), personal counseling, and [federally funded programs](#). For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to resources@uta.edu, or view the information at <http://www.uta.edu/studentsuccess/success-programs/programs/resource-hotline.php>

Course Schedule

Week	Exams	Topic
Week 1 (8/22 – 8/26)		<ul style="list-style-type: none"> • Course Overview • Introduction • Computer Abstractions and Technology
Week 2 (8/27 – 9/2)		<ul style="list-style-type: none"> • Computer Organization Overview • Binary review & Structured computers
Week 3 (9/3 – 9/9)		<ul style="list-style-type: none"> • Labor Day Holiday (Sep 3) • Signed Numbers & Hexadecimal • Instructions & Endianness
Week 4 (9/10 – 9/16)		<ul style="list-style-type: none"> • Registers vs. Memory • Logical Operations Instructions
Week 5 (9/17 – 9/23)		<ul style="list-style-type: none"> • Procedure & Addressing Modes • Assembly Language • Control Flow
Week 6 (9/24 – 9/30)		<ul style="list-style-type: none"> • Macros, Assembler directives • Assembly process & Pseudo Instructions • Memory Maps • Linking/Loading
Week 7 (10/1 – 10/7)	Midterm Exam	<ul style="list-style-type: none"> • Midterm Review • Midterm
Week 8 (10/8 – 10/14)		<ul style="list-style-type: none"> • Strings and printing • Virtual Machine

Week 9 (10/15 – 10/21)		<ul style="list-style-type: none"> • Running ARM Programs in QEMU • Debugging ARM Programs with GDB
Week 10 (10/22 – 10/28)		<ul style="list-style-type: none"> • Processor Pipeline & Parallel processing • Input/Output (I/O) • Exceptions and Interrupts
Week 11 (10/29 – 11/4)		<ul style="list-style-type: none"> • More on Exceptions and Interrupts • Memory Hierarchies
Week 12 (11/5 – 11/11)		<ul style="list-style-type: none"> • More on Memory Hierarchies • (Registers, Caches, Main Memory, Storage)
Week 13 (11/12 – 11/18)		<ul style="list-style-type: none"> • Virtual Memory • Dependable Memory
Week 14 (11/19 – 11/25)		<ul style="list-style-type: none"> • Error Detection • Detecting Overflow (ARM) & Floating Point (IEEE 754) • Compiler optimizations
Week 15 (11/26 – 11/ 28)		<ul style="list-style-type: none"> • Review Week
	<u>Final Exam</u>	Wednesday, Dec 12 (11 – 1:30 p.m.)

**** As the instructor for this course, I reserve the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course.**

–Fred Kashefi.